CLAIMS

1. A Group III nitride semiconductor multilayer structure comprising a substrate; an $Al_xGa_{1-x}N$ ($0 \le x \le 1$) buffer layer which is provided on the substrate and has a columnar or island-like crystal structure; and an $Al_xIn_yGa_{1-x-y}N$ ($0 \le x \le 1$, $0 \le y \le 1$, $0 \le x + y \le 1$) single-crystal layer provided on the buffer layer, wherein the substrate has, on its surface, non-periodically distributed grooves having an average depth of 0.01 to 5 μm.

2. A Group III nitride semiconductor multilayer structure according to claim 1, wherein the grooves have an average depth of 0.1 to 1 μm.

3. A Group III nitride semiconductor multilayer structure according to claim 1 or 2, wherein the substrate is formed of sapphire single crystal or SiC single crystal.

4. A Group III nitride semiconductor multilayer structure according to any one of claims 1 through 3, wherein the buffer layer contains columnar crystal grains.

5. A Group III nitride semiconductor multilayer structure according to any one of claims 1 through 4, wherein the buffer layer has a thickness of 1 to 100 nm.

6. A Group III nitride semiconductor multilayer structure according to any one of claims 1 through 5, wherein the buffer layer is formed through continuously feeding of a Group III element source and a nitrogen source such that the ratio of nitrogen to a Group III element becomes 1,000 or less, or through feeding of merely a Group III element source (in the case where the nitrogen/Group III element ratio is zero).

7. A Group III nitride semiconductor multilayer structure according to any one of claims 1 through 6, wherein the single-crystal layer has a thickness of 1 to 20 μm.

8. A Group III nitride semiconductor multilayer structure according to any one of claims 1 through 7, wherein the single-crystal layer is formed through feeding of a Group III element source and a nitrogen source such that the nitrogen/Group III element ratio becomes 1,600 to 3,200.

9. A Group III nitride semiconductor multilayer structure according to any one of claims 1 through 8, wherein the single-crystal layer is formed while the temperature of the substrate is regulated so as to fall within a range of 1,000 to 1,300°C.

10. A Group III nitride semiconductor multilayer structure according to claim 9, wherein the temperature of the substrate is regulated so as to fall within a range of 1,050 to 1,200°C.

11. A Group III nitride semiconductor light-emitting device comprising a Group III nitride semiconductor multilayer structure according to any one of claims 1 through 10; Group III nitride semiconductor layers provided atop the single-crystal layer of the semiconductor multilayer structure, the semiconductor layers including an n-type layer, a light-emitting layer, and a p-type layer; and a negative electrode and a positive electrode which are provided at predetermined positions.

12. A Group III nitride semiconductor light-emitting device according to claim 11, wherein the n-type layer, the light-emitting layer, and the p-type layer, which constitute the Group III nitride semiconductor layers, are successively provided atop the single-crystal layer in this order; the negative electrode is provided on the n-type layer; and the positive electrode is provided on the p-type layer.

13. A substrate for forming a Group III nitride semiconductor, which has, on its surface, non-periodically distributed grooves having an average depth

of 0.01 to 5 μm.

14. A substrate for forming a Group III nitride semiconductor according to claim 13, wherein the grooves have an average depth of 0.1 to 1 μm.

15. A substrate for forming a Group III nitride semiconductor according to claim 13 or 14, which is formed of sapphire single crystal or SiC single crystal.

16. A method for producing a Group III nitride semiconductor multilayer structure, comprising a step of forming an $Al_xGa_{1-x}N$ ($0 \leq x \leq 1$) buffer layer by feeding, onto a heated substrate which has, on its surface, non-periodically distributed grooves having an average depth of 0.01 to 5 μm, a Group III element source and a nitrogen source such that the ratio of nitrogen to a Group III element becomes 1,000 or less, or by feeding, onto the substrate, merely a Group III element source (in the case where the nitrogen/Group III element ratio is zero); and subsequently a step of vapor-growing an $Al_xIn_yGa_{1-x-y}N$ ($0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq x + y \leq 1$) single-crystal layer atop the buffer layer by use of a Group III element source and a nitrogen source.

17. A method for producing a Group III nitride semiconductor multilayer structure, comprising a buffer layer formation step in which a Group III element source and a nitrogen source are fed onto a substrate having, on its surface, non-periodically distributed grooves having an average depth of 0.01 to 5 μm while the temperature of the substrate is maintained at 400 to 600°C, to thereby form an $Al_xGa_{1-x}N$ ($0 \leq x \leq 1$) layer, and subsequently feeding of the Group III element source is stopped, followed by thermal treatment at 900 to 1,000°C; and subsequently a step of vapor-growing an $Al_xIn_yGa_{1-x-y}N$ ($0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq x + y \leq 1$) single-crystal layer atop the buffer layer by use of a Group III element source and a nitrogen source.